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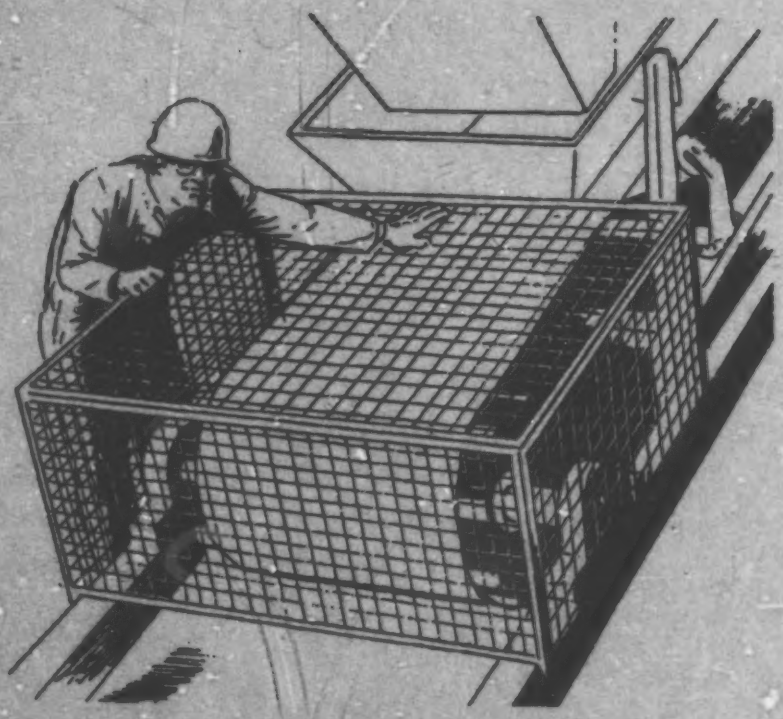
MSHA's Guide to Equipment Guarding at Metal and Nonmetal Mines

U.S. Department of Labor
Mine Safety and Health Administration

Revised 1990



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INTRODUCTION

This guide on mechanical safeguarding will assist industry, labor and inspectors of the Mine Safety and Health Administration obtain uniformity throughout the metal and nonmetal mining industry.

The illustrations in this booklet show expanded metal guards. This was done to simplify the drawings. In no way should this be misunderstood to mean that all guarding must use expanded metal. However, the use of expanded metal or sizing screens does have several advantages. Some of these advantages are:

1. The area guarded can be inspected without removing the guard.

2. Grease fittings and oil cups can be placed through the openings without cutting large holes in the guard. (Large holes should not be cut in guards to gain access to grease fittings--grease fittings should be extended so that lubrication can be accomplished from a safe location.)

3. At most operations this material is readily available (e.g., worn screen cloth, etc.)

4. In certain circumstances, the use of expanded metal guards allows smaller particles of spilled material to pass through the guard with minimal buildup.

BASIC PRINCIPLES OF GUARDING

Mandatory standard 30 CFR 56/57.14107(a) specifies that "moving machine parts shall be guarded to protect persons from contacting gears, sprockets, chains, drive, head, tail and takeup pulleys, flywheels, couplings, shafts, fan blades, and similar moving parts that can cause injury."

Many accidents result from moving machinery, and persons working on or around machinery must be protected. The installation and maintenance of machinery and machine guards are governing factors in controlling and preventing accidents and injuries. In devising protection against moving machinery and machine parts, the goal should be to make it as effective as possible. All possible contingencies should be considered, including acts of thoughtlessness and foolhardiness, in guarding machinery to prevent injuries.

An effective machine guard should have certain characteristics in design and construction. Such a guard should:

1. Be considered a permanent part of the machine or equipment.
2. Afford maximum protection.
3. Prevent access to the danger zone during operation.
4. Be convenient; it must not interfere with efficient operation.
5. Be designed for the specific job and specific machine, with provisions made for oiling, inspecting, adjusting, and repairing machine parts.
6. Be durable and constructed strongly enough to resist normal wear.
7. Not present a hazard in itself.

When the installation of guards is contemplated, persons who have a specific interest in them should be consulted. The opinion of the operator of the machine, the supervisors, the maintenance personnel, and the oilers should be solicited. However, it must be kept in mind that protective guards placed around moving machinery should completely enclose the moving part and should be positioned so the moving equipment or pinch point which presents a hazard cannot be reached.

Materials for guards should be carefully selected. For most installations, guards of bar stock, sheet metal, perforated metal, expanded metal, or heavy wire mesh are more satisfactory than those of other materials.

The larger guards frequently are of pipe or a structural steel frame supporting wood, solid sheet metal, or wire mesh that will provide a barrier against moving parts.

Guards of wood lack durability and strength, have relatively high maintenance cost, and are flammable. Therefore, their use is limited.

Guardrails and toeboards frequently are installed around flywheels, hoisting equipment, etc., and are applicable to many other kinds of mechanical equipment.

THE TECHNIQUES OF MECHANICAL GUARDING

It is recognized that a given situation--a hazard-creating motion or action--may frequently be guarded in a number of ways, several of which may be satisfactory. The selection of a guarding method to be used may depend upon a number of things--space limitations, production methods, size of stock, and frequency of use. Other factors may be important in making the final decision. Moving machine parts, nip points and pinch points must be guarded individually rather than by restricting access to the areas by installing railings. It is not the intent of this guide to suggest which method of guarding is the best for a given situation, but rather to show that there are a number of ways to guard. This will be done by illustrating typical situations which may be guarded by a variety of methods.

In the following illustrations, the various motions and actions are shown without guards; also, they are shown with typical guards illustrating the various guarding techniques along with written explanation for your thought and guidance. It is not possible to apply all of the guarding techniques to all of the motions or actions, but an effort has been made to show those situations that are frequently found in the mining industry.

FIGURES 1 and 2

Figure 1 shows a self-cleaning tail pulley with an inadequate guard. The guards are placed too far from pulley, leaving the fins and pinch points exposed.

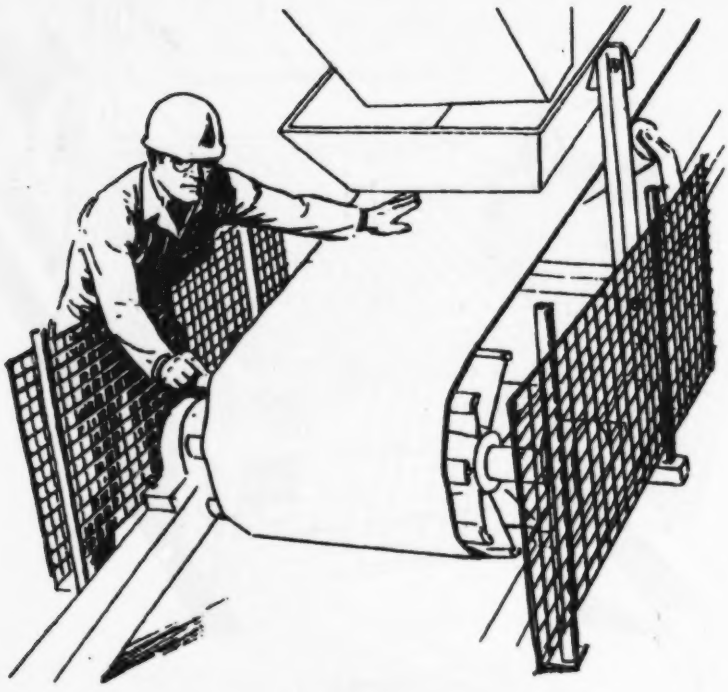

Figure 1

This type of pulley should be totally guarded as shown in Figure 2. The guard also covers the pinch point created by the transfer chute.

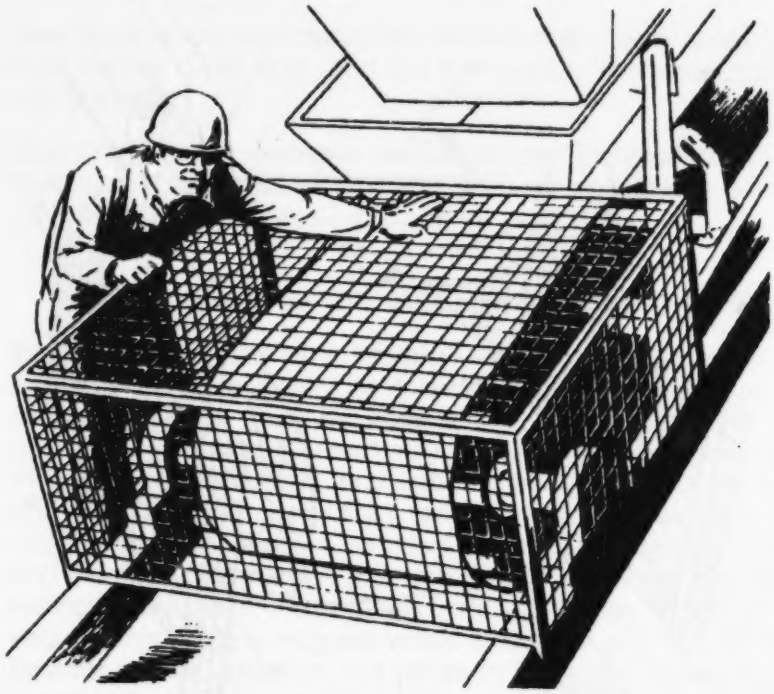

Figure 2

FIGURES 3 and 4

The guard for the tail pulley in Figure 3 does not cover the pinch point and therefore is not effective.

A smooth pulley can be totally enclosed, or guarded along the sides as shown in Figure 4.

Side guards are only effective when placed close to the pulley and extended a distance sufficient so the pinch points cannot be reached from the front, the back or the top.

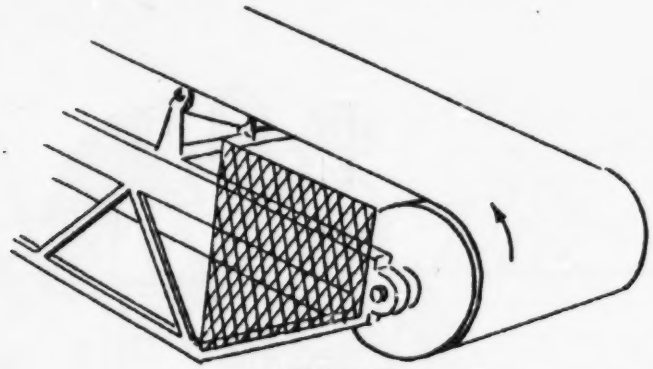

Figure 3

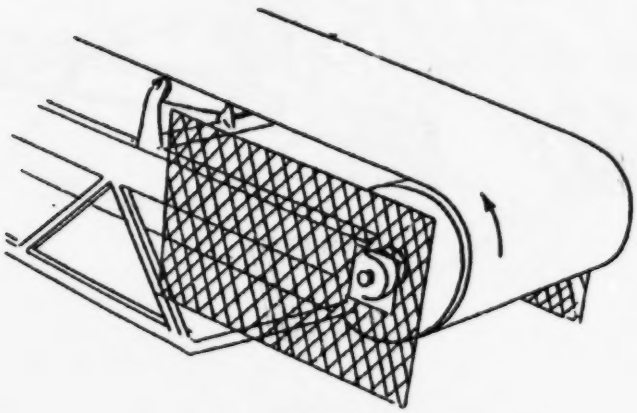

Figure 4

FIGURE 5

Remote areas protected by location need not be guarded. However, if work is performed at such location as shown in Figure 5, the equipment must be deenergized and locked out and a temporary safe means of access (ladder) provided before any work is started.

Figure 5

FIGURES 6 and 7

The reason for guarding return idlers is shown in Figure 6. They should be guarded if someone could be injured while working or passing underneath the belt. It is reasonable to expect these types of accidents where the idlers are between two feet and seven feet above the walking surface.

Return idlers can be guarded individually, by blocking access underneath the conveyor, or by completely enclosing the area under the return side of the belt.

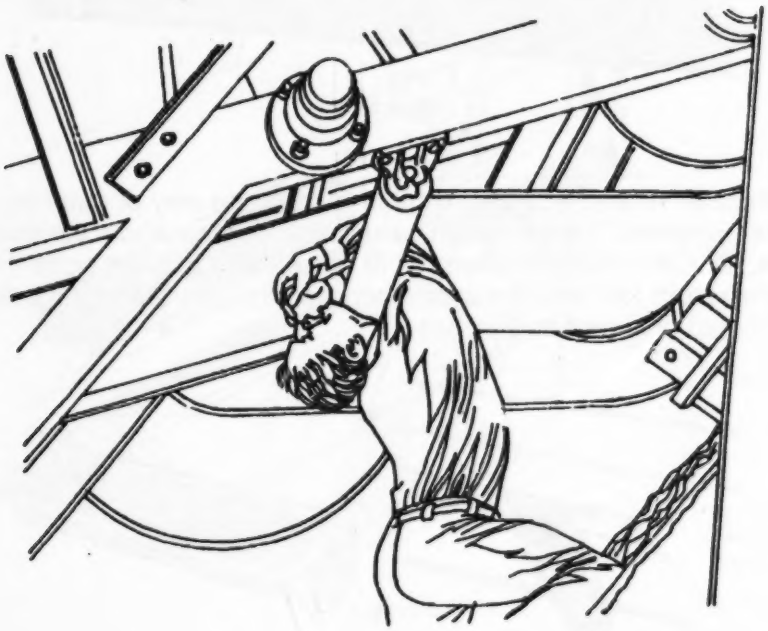

Figure 6

Figure 7a shows one method of guarding return idlers. Notice that grease fittings can be accessed without removing the guard. The mesh openings should be large enough to allow fines to fall through, but not large enough for a person's hand to go through.

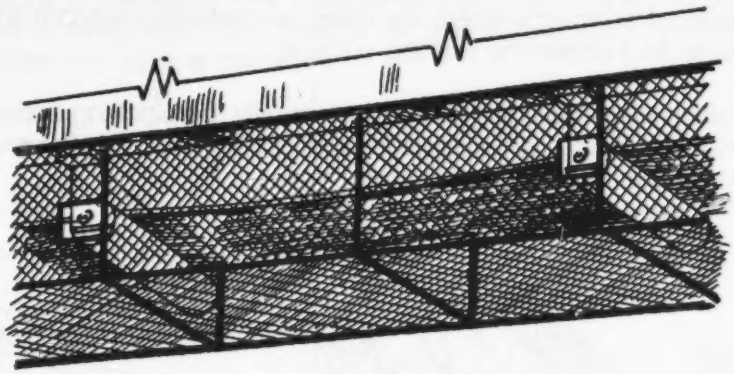

Figure 7a

Figures 7b and 7c show another acceptable way of guarding return idlers. The guard can be installed with or without the end caps. Care must be taken not to place the guard too close to the return idler and the space between the guard and the belt should only be 1 to 2 inches.

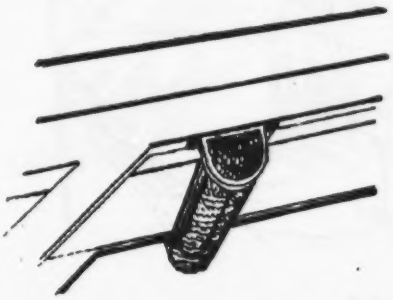

Figure 7b

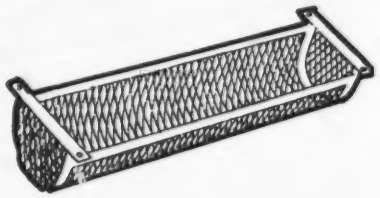

Figure 7c

FIGURES 8 and 9

An unguarded head pulley and drive unit are shown in Figure 8.

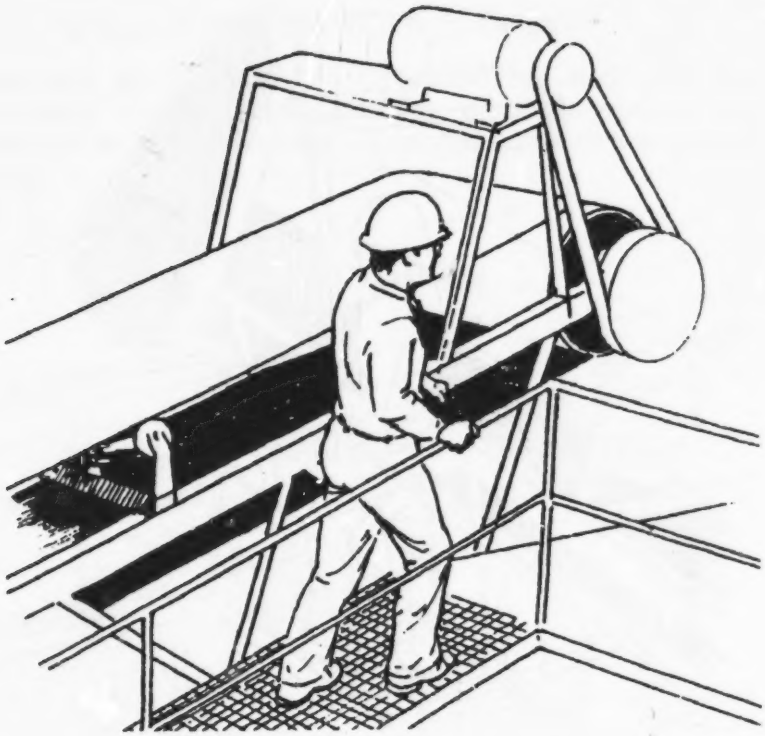

Figure 8

Figure 9 shows the guard in place. The head pulley guard is extended so the pinch point cannot be reached.

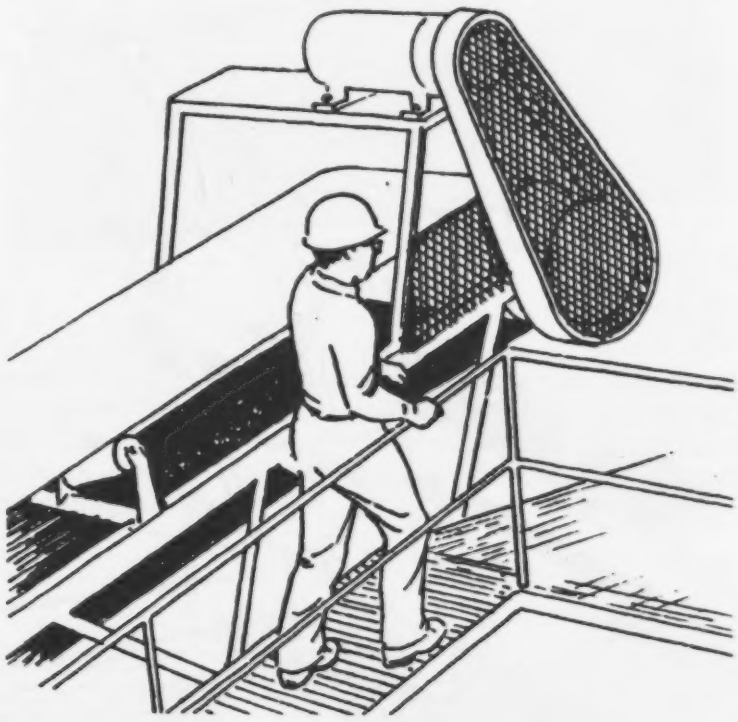

Figure 9

FIGURE 10

A stop cord along a conveyor belt with an adjacent travelway is shown in Figure 10. The stop cord is located alongside and above the belt for the following reasons:

1. It is within easy reach.
2. A person falling against the belt will automatically trip the cord.
3. Spillage from the belt will not trip the cord.

Standard 30 CFR 56/57.14109 should be used when the travelway is next to the conveyor, or where persons are required to travel alongside unguarded conveyors at ground level.

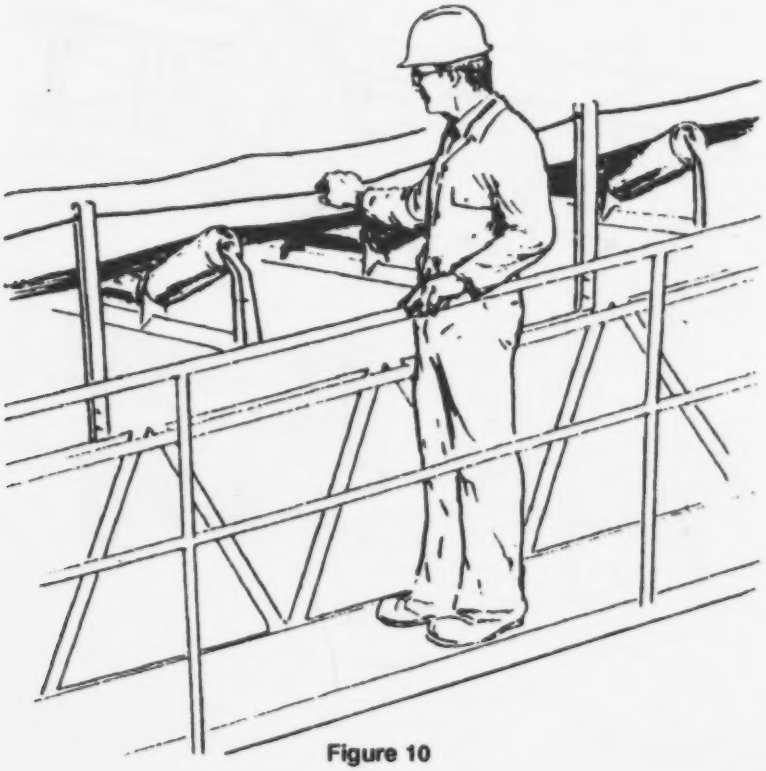

Figure 10

FIGURE 11

In this drawing, a railing is installed along the conveyor in lieu of a stop cord. This may be considered as a guarded conveyor. The railing is placed away from and slightly above the belt to prevent contact with the moving belt.

In cases where cables are used for railings, they must be kept tight and free of burrs.

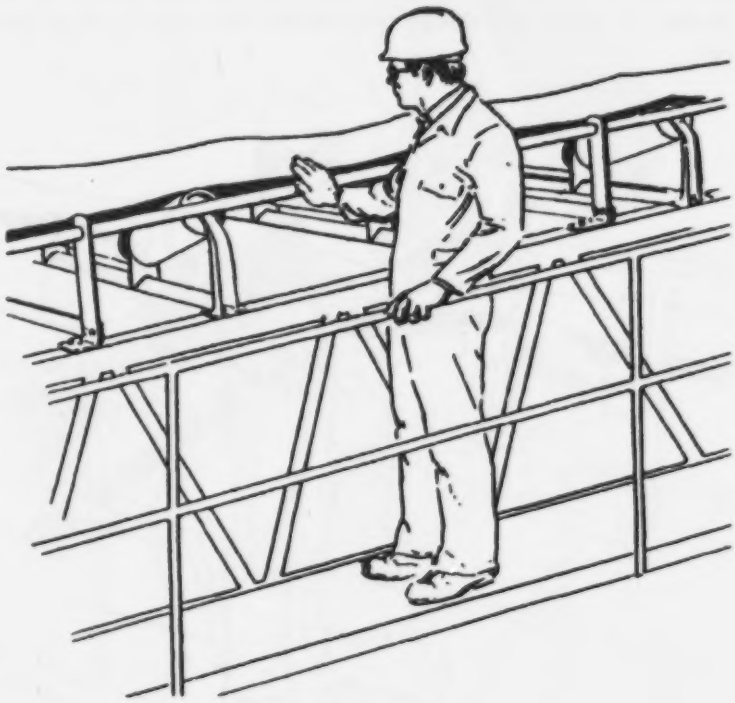

Figure 11

FIGURES 12 and 13

An unguarded takeup pulley is shown in Figure 12. The structure of the conveyor should not be considered as a guard.

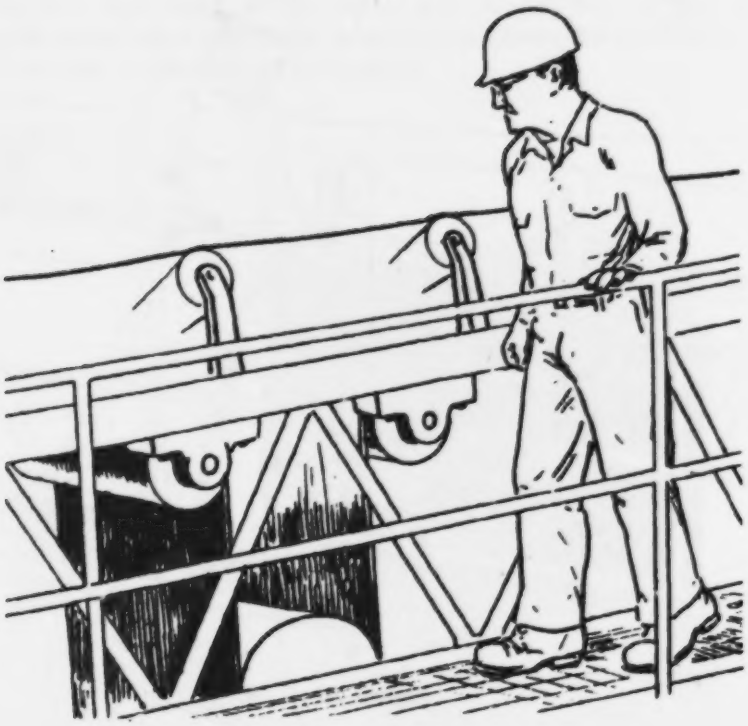

Figure 12

A simple guard (as shown in Figure 13) can be installed to prevent access to the pinch points.

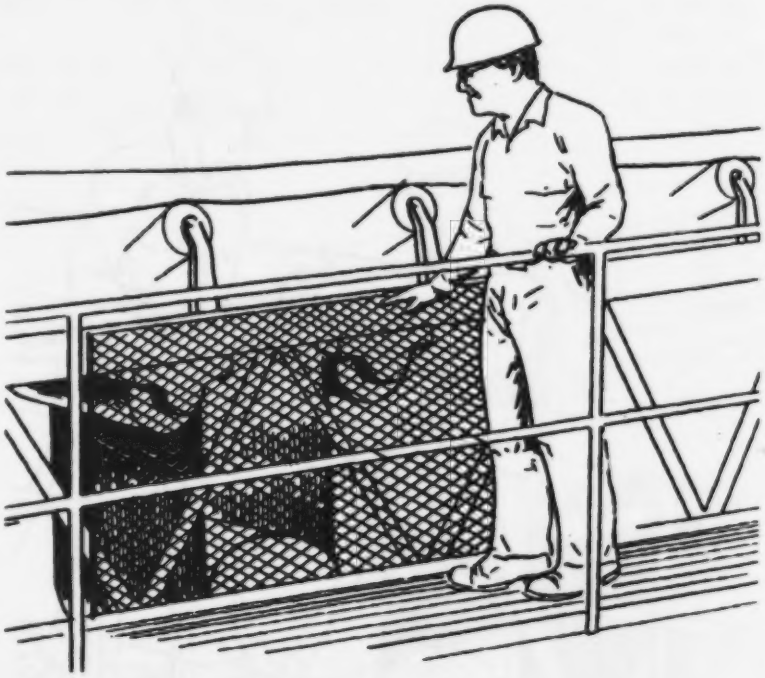

Figure 13

FIGURE 14

When belt dressing is applied as shown in Figure 14, the conveyor must be deenergized and locked out as specified in mandatory standard 30 CFR 56/57.12016.

Serious injuries have occurred when belt dressing was being applied to moving belts. Mandatory standard 30 CFR 56/57.14203 specifically states: "Belt dressings shall not be applied manually while belts are in motion unless a pressurized-type applicator is used that allows the dressing to be applied from outside the guards."

Figure 14

FIGURES 15 and 16

Takeup pulleys with counterweights can be guarded as shown.

The guard in Figure 15 prevents access to the danger zone where the guides reach ground level.

Figure 16 shows a suspended conveyor with the guides blocked by a bar to prevent the counterweight from dropping to ground level in case of belt breakage. Cables, for additional safety, are fastened to the structure.

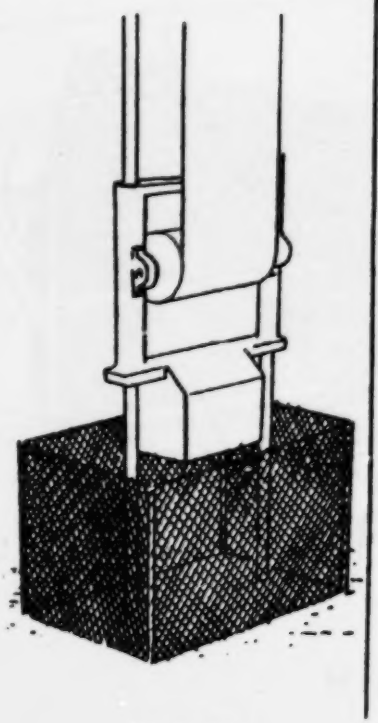

Figure 15

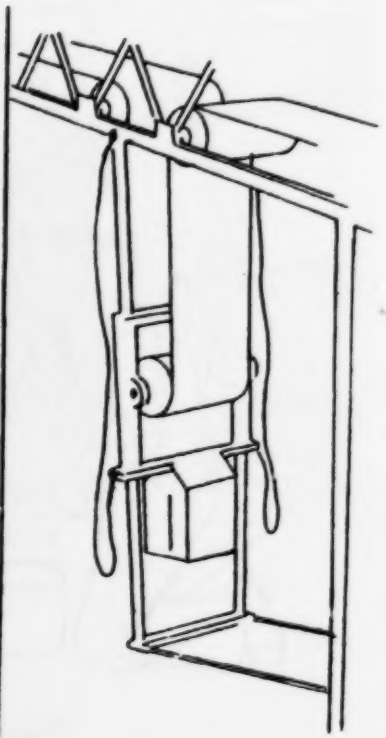

Figure 16

FIGURES 17 and 18

Drive shafts with protruding set screws, keys and key ways (Figure 17) shall be guarded, as shown in Figure 18.

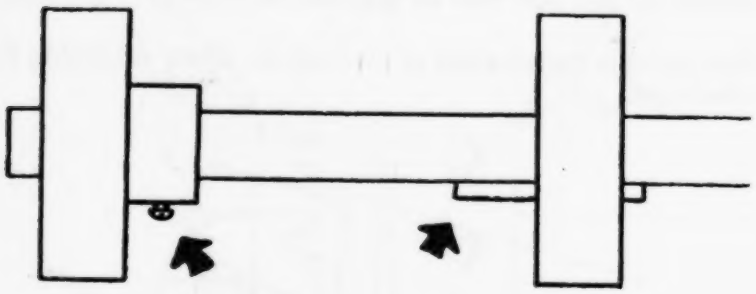

Figure 17

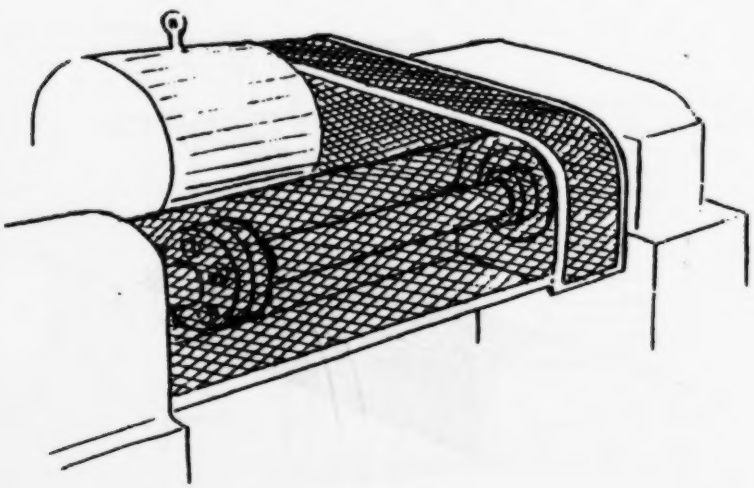

Figure 18

FIGURES 19 and 20

A power take-off shaft with universal joints is shown in Figure 19.

This type of shaft is primarily used for portable crushing equipment and can best be guarded as shown in Figure 20.

The guard is constructed of two halves, totally enclosing the drive shaft.

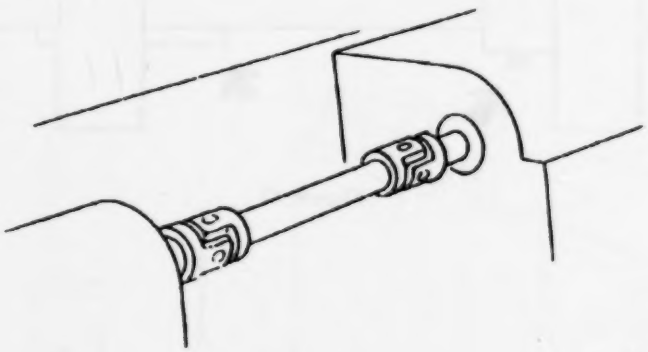

Figure 19

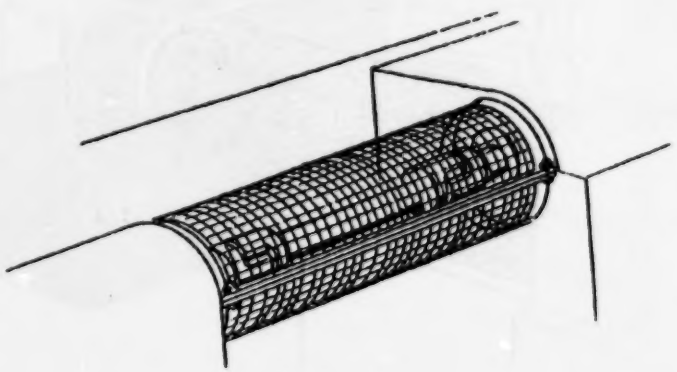

Figure 20

FIGURES 21 and 22

A drive coupling is shown in Figure 21.

Couplings of this type should be totally enclosed as shown in Figure 22.

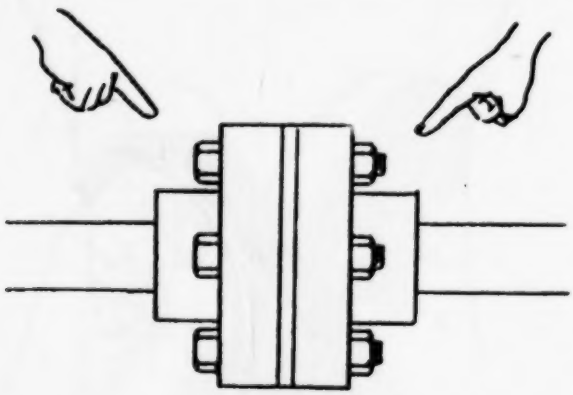

Figure 21

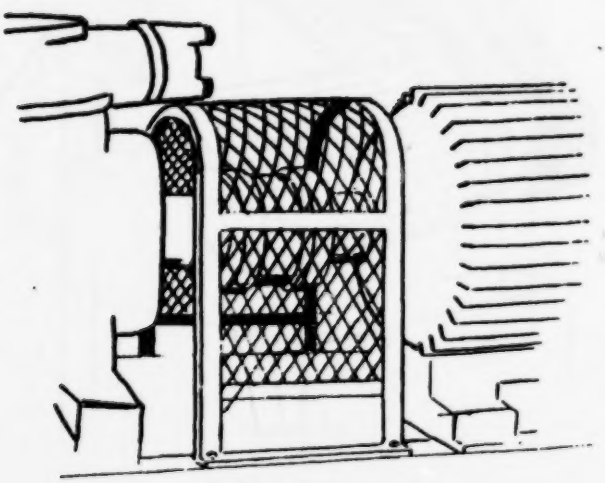

Figure 22

FIGURES 23 and 24

A guard for a drive belt and pulleys is shown in Figure 23. This type of guard is adequate where the belts and pulleys are accessible from the front only.

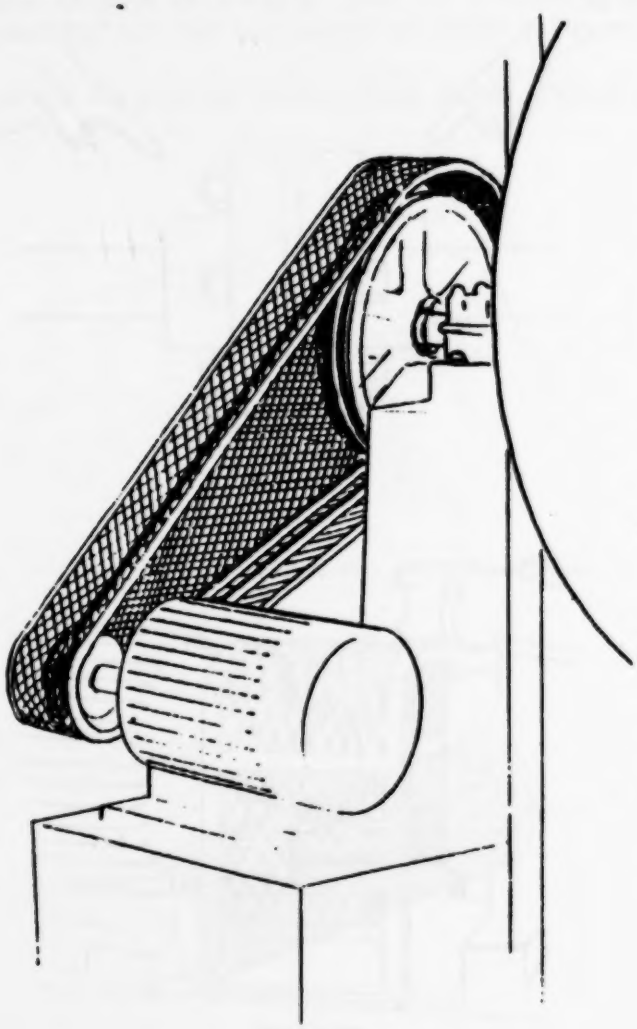

Figure 23

However, where access is possible from both sides, the belts and pulleys should be totally enclosed as shown in Figure 24.

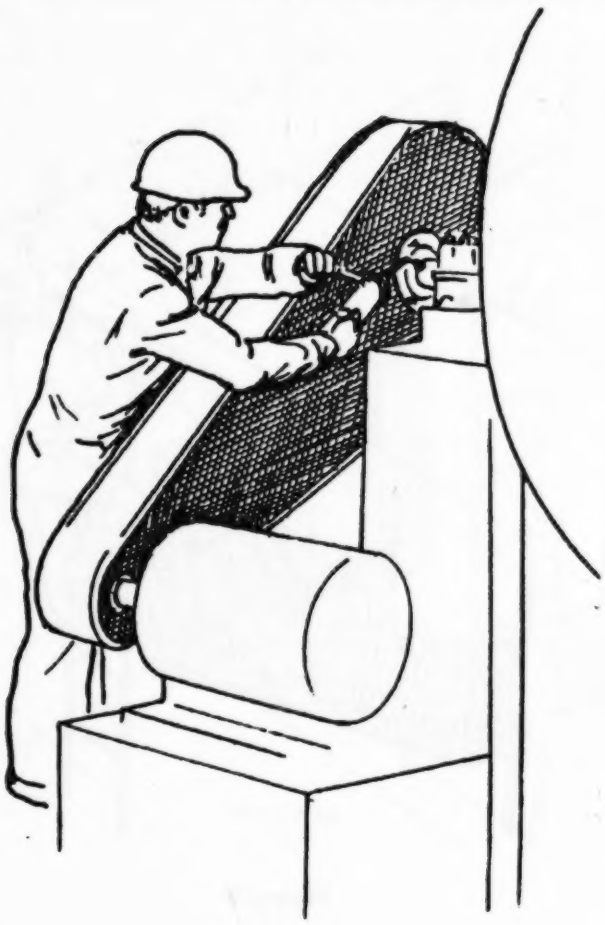

Figure 24

FIGURES 25 and 26

Whenever hazards are created by belt breakage to persons working or traveling nearby, as shown in Figure 25, the drive should be totally enclosed as shown in Figure 26.

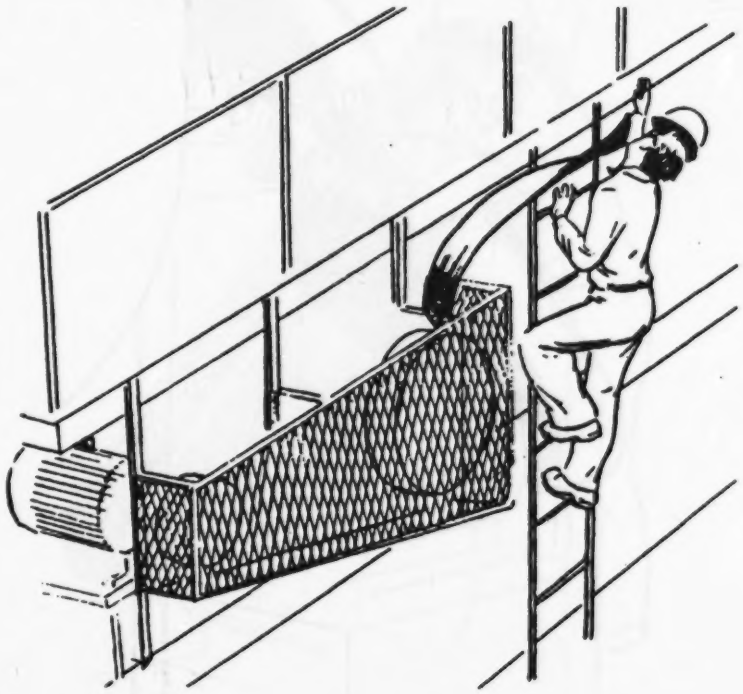

Figure 25

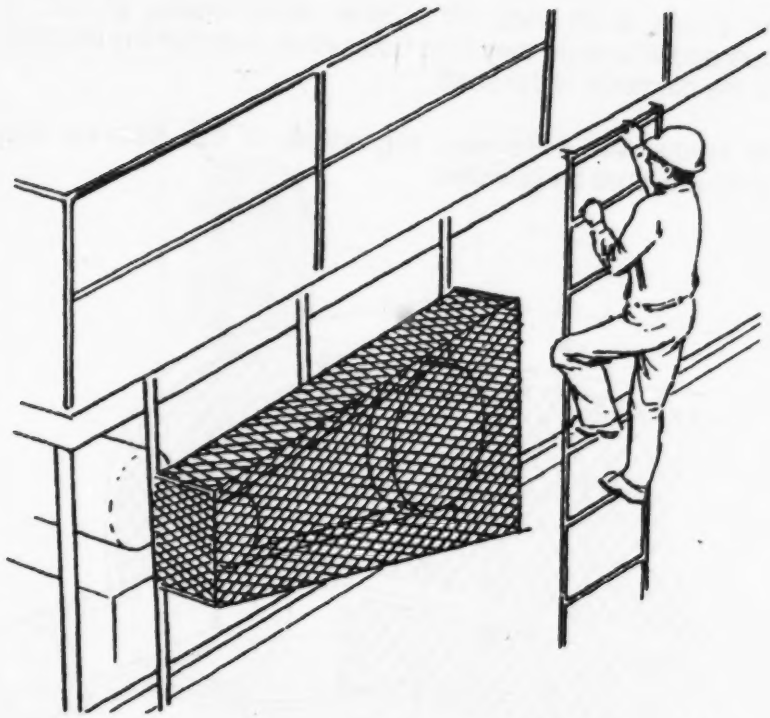

Figure 26

FIGURE 27

An effective way of guarding protruding shaft ends is shown in Figure 27. A simple sleeve with an end cap is placed over the shaft, thereby preventing any contact.

As a rule, shaft ends, other than keyed shafts, should be guarded whenever they protrude further than half the distance of the diameter of the shaft.

All shafts with a keyway, regardless of the distance they protrude, shall be guarded.

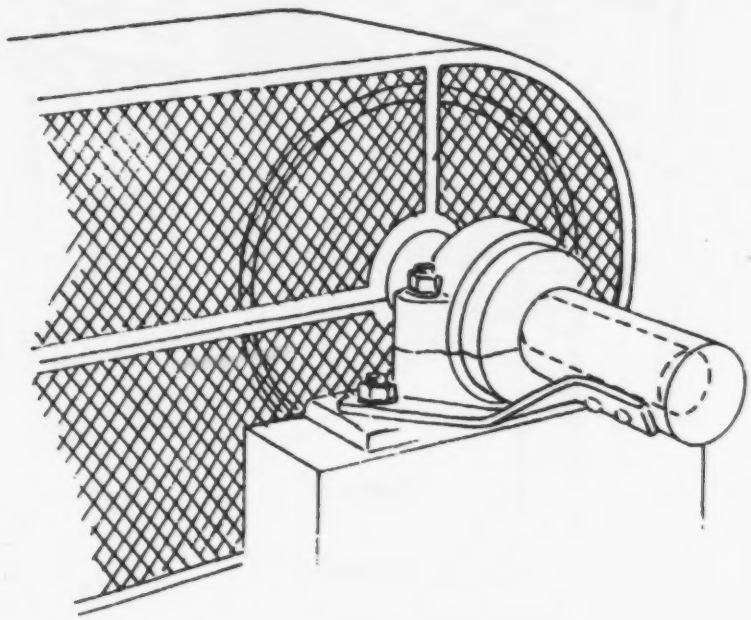

Figure 27

FIGURE 28

Fan inlets must be guarded to prevent contact with fan blades.

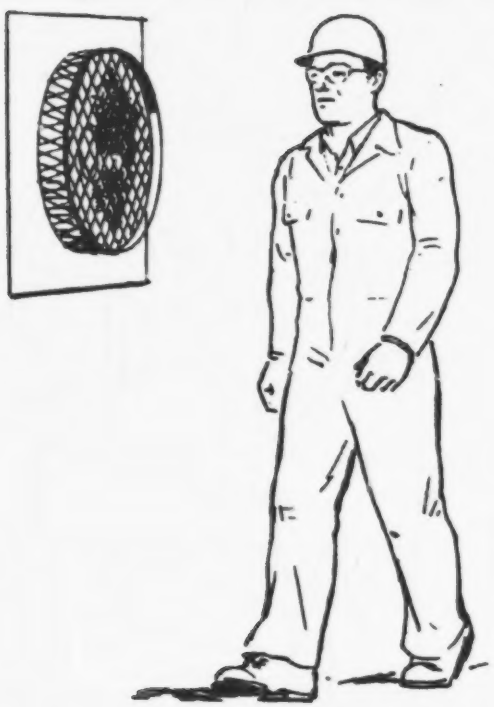

Figure 28

FIGURES 29, 30 and 31

Figure 29 shows a flywheel guarded by location (7 feet or above). A build-up of material can, at times, place the flywheel within easy reach, as shown in Figure 30. If a build-up of material places the unguarded flywheel within seven feet of the walking surface, it must be guarded.

Where it is not necessary to totally enclose the flywheel, a guard as shown in Figure 31 may be used.

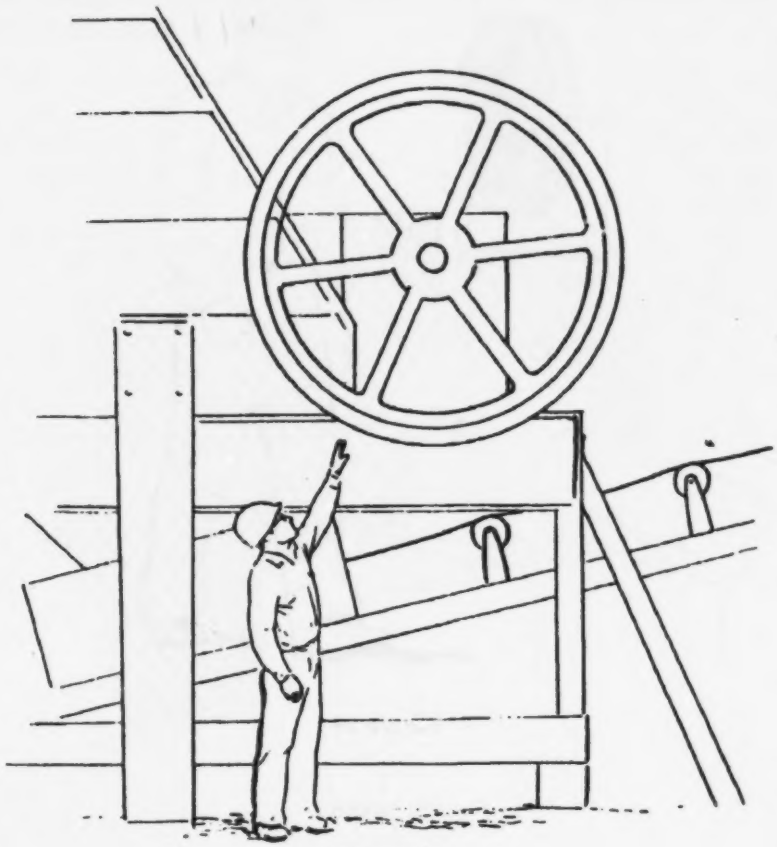

Figure 29

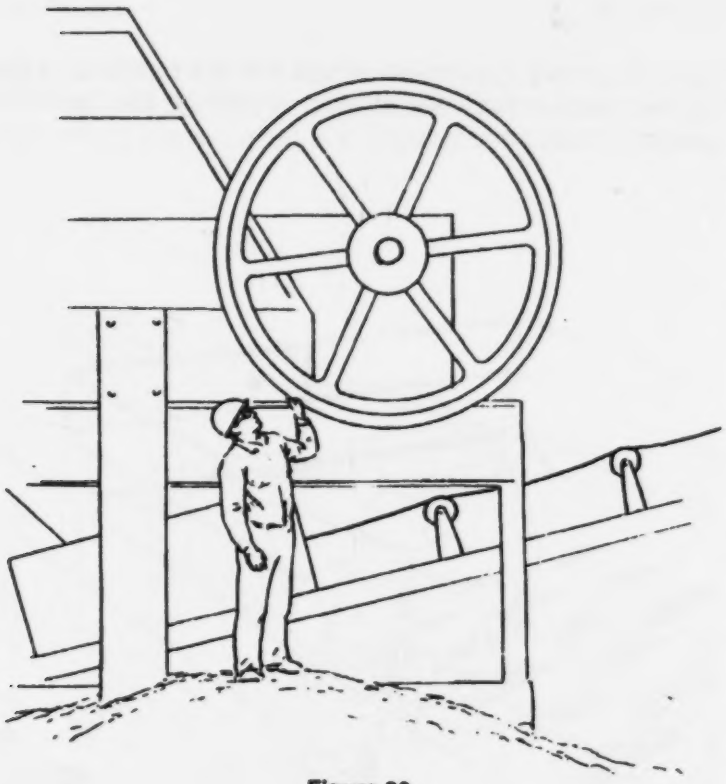

Figure 30

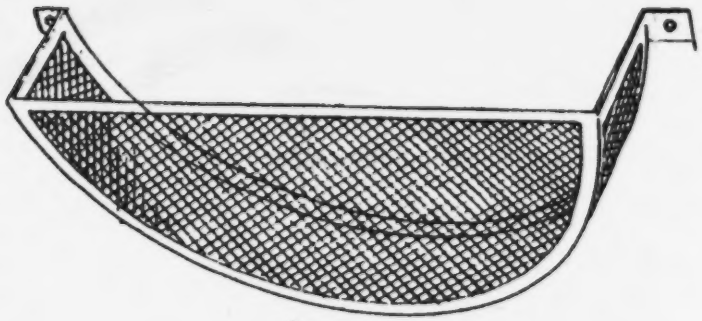

Figure 31

FIGURE 32

Figure 32 shows a classifier. When it is not practical to guard machine parts individually, protective railings can be installed to restrict access.

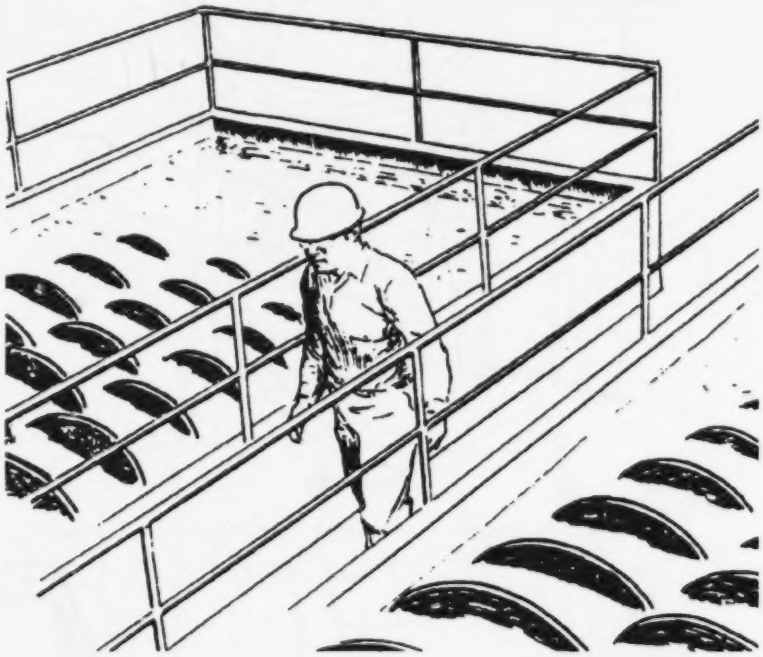

Figure 32

FIGURE 33

Figure 33 shows a dryer with a railing restricting access to the trunnions. This should not be considered as a guard, since the pinch points are exposed and present a hazard to servicing personnel.

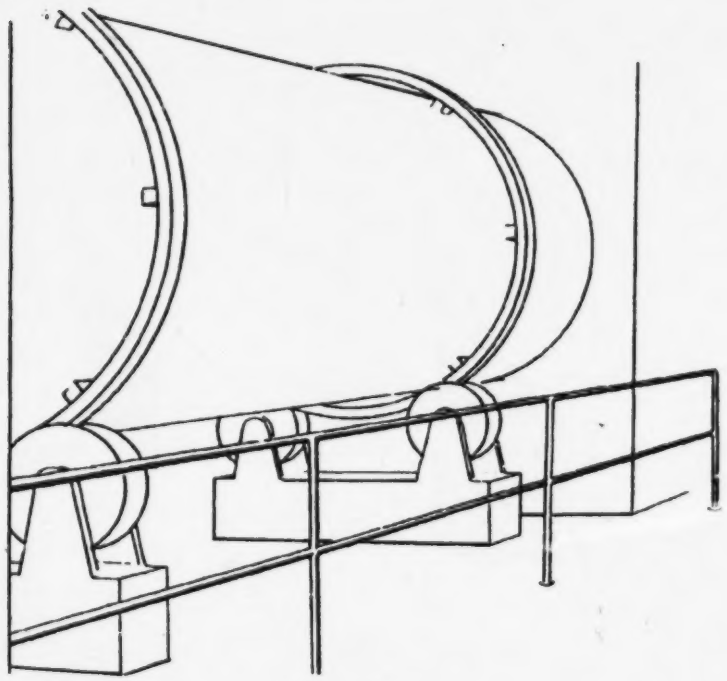

Figure 33

FIGURE 34

Figure 34 shows the trunnions with individual guards. This is an effective way to cover the pinch points. The grease fittings can be extended through the guard, so servicing can be done while the dryer is in motion.

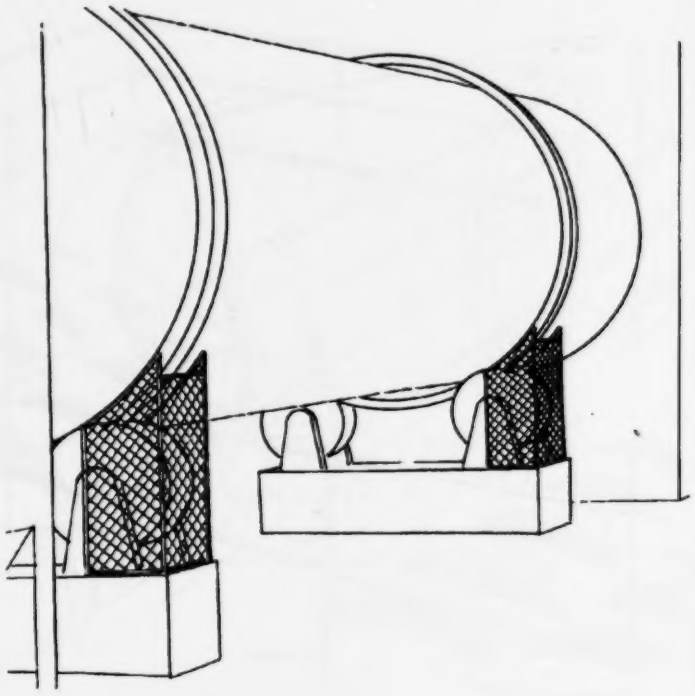

Figure 34